

In the claims:

1. (currently amended) A system for aiding a person with a visual impairment or visual obstruction, comprising:

means for sensing time/space characteristics and physical characteristics information about a plurality of objects in a field of view of said person;

means for identifying, interpreting, decomposing, and synthesizing said time/space characteristics and physical characteristics information and for high-level characterizing said plurality of objects in an object class; and

means for verbally communicating output and input information between said system and said user,

wherein said output information further comprises a scene description about said surrounding environment within the field of view of said person, and

wherein said scene description is verbally communicated in conversational speech to said person based on the distance of said plurality of objects to said user, the closest being communicated first as having a higher priority,

wherein said scene description comprises ~~a hierarchy of object classes~~ said plurality of objects identified by said system, together with properties such as their position information, physical characteristics, and relative velocity vectors indicating motion, and

wherein said properties are provided by an Object Synthesis and Recognition module which associates said properties with an identified object class.

2. (currently amended) The system ~~according to~~ of claim 1, wherein said means for sensing comprises image sensing devices selected from the group consisting of: CCD sensors, and a 3-D laser imaging sensor.

3. (currently amended) The system ~~according to~~ of claim 1, wherein said time/space characteristics and physical characteristics information about an object includes any of: physical dimensions, general shape description, texture, color, the distance and position of said user from said object, motion of said object, spatial relationships between objects.

4. (currently amended) The system ~~according to~~ of claim 1, wherein said means for interpreting said time/space and physical characteristics information comprises: a Sensors Processor and Control Unit (SPC) for interpreting low-level sensing data from said sensing means, and a High-level Vision Processing module for interpreting high-level sensing data from said sensing means.

5. (currently amended) The system ~~according to~~ of claim 1, further comprising a World Model knowledge database for performing said high-level characterizing.

6. (deleted)

7. (currently amended) The system ~~according to~~ of claim 5, wherein said World Model database is continuously enriched by adaptation to new experiences of said person and implemented in at least one option selected from the modes:

direct teaching mode;
generalization teaching mode by positive enforcement or
default; and
refinement teaching mode by negative enforcement or
correction.

8-9. (deleted)

10. (currently amended) An apparatus for aiding a visually
impaired or blind person to detect and identify ~~said~~ a
plurality of objects in his field of vision, comprising:

at least one computerized imaging device for detecting
and identifying said plurality of objects;

a Processing and Control Unit for receiving and
processing information from said at least one computerized
imaging device and said person; and

a User Interface Module for receiving instructions from
said Processing and Control Unit for the purpose of verbally
describing to said person said plurality of objects in said
field of vision, thereby enabling said person to cope with
and proceed in the surroundings.

11-25. (deleted)

26. (currently amended) The apparatus ~~according to~~ of claim
10, further comprising an automatic speech recognition unit
for verbal input of instructions from said person to said
Processing and Control Unit.

27. (currently amended) A computer program product
comprising a computer usable medium having computer readable
code embodied therein for execution on a general purpose
computer, said computer usable medium storing instructions
that, when executed by the computer, cause the computer to

perform [A] a method for detecting, analyzing, identifying, and reporting a plurality of objects by name to a visually impaired or blind person in a field of view of said person, comprising the steps of:

providing a 3-D laser imaging system to accurately measure both the coordinates of said plurality of objects in both static and dynamic motion and the characterization of the relationships between said plurality of objects in relation to said person;

acquiring a plurality of 3-D visual images and information about said plurality of objects;

processing said plurality of 3-D visual images and said information;

storing said information of said plurality of objects by names in a hierarchy utilizing a structured World Model;

identifying said plurality of objects, and

communicating verbally with said person to report said information about said plurality of objects in said field of view,

reflecting and capturing laser pulses from the surfaces of said plurality of objects present in close range to said person to produce a "cloud" of spatial pixels (voxels) representing points on all said surfaces which can be observed from said person's point of view;

applying a set of low-level algorithms to decompose said "cloud" into a set of regular surfaces defined by parameters of type, dimensions, orientation in space, and relative (to said user) velocity vector; and

applying a set of high-level algorithms to act on said surfaces to combine them into identified 3-D objects with assigned names.

28-30. (deleted)

31. (currently amended) The method ~~according to~~ of claim 27 further comprising 3-D object rendering.

32-34. (deleted)

35. (currently amended) The method ~~according to~~ of claim 27, further comprising communicating the verbal description of the scene related to said plurality of objects in said field of vision to said person.

36. (currently amended) A system for aiding a person with a visual impairment or visual obstruction, comprising:

means for sensing time/space characteristics and physical characteristics information about the physical environment in a field of view of said person;

means for identifying, interpreting, decomposing, and synthesizing said time/space characteristics and physical characteristics information and for high-level characterizing said physical environment; and

means for verbally communicating a scene description ~~describing~~ which describes to said user the characterization of and said interpretation about said physical environment.

37. (currently amended) The system ~~according to~~ of claim 36, wherein said means for sensing comprises image sensing devices selected from the group consisting of: CCD sensors, and a 3-D laser imaging sensor.

38. (currently amended) The system ~~according to~~ of claim 5, wherein said world Model database comprises data selected from the group of:

physical descriptions of known objects and components thereof;

the relations of said objects to their respective said components;

common relationships among said components;

groupings of said known objects into classes and subclasses;

common properties of said classes, subclasses and groupings; and

common relations among and between said classes, subclasses and groupings.

39. (currently amended) The system ~~as in~~ of claim 7 wherein said direct teaching mode comprises giving a name to a part of a scene by said user.

40. (currently amended) The system ~~as in~~ of claim 7 wherein said generalization teaching mode comprises identifying a part of a given scene as belonging to a specific object class, although some of the relationships, or some of the components, may deviate from that identified in said database.

41. (currently amended) The system ~~as in~~ of claim 7 wherein said refinement teaching mode comprises refining the set of definitions to permanently exclude in the future an identification of only part of a scene as belonging to a

specific object class when said user has rejected said partial identification.

42. (currently amended) The apparatus ~~according to~~ of claim 10 wherein said User Interface Module receives verbal instructions from said person in a direct teaching mode to improve said World Model knowledge database capabilities for naming and classifying a plurality of objects within said field of view.

43. (currently amended) The system ~~according to~~ of claim 1, wherein said means for interpretation comprises scene interpretation data and sensed data streams.

44. (currently amended) The system ~~according to~~ of claim 1, wherein said means for interpretation further comprises computations for relating distances and color information of said plurality of objects and components thereof within the field of vision of said person.

45. (currently amended) The system ~~according to~~ of claim 1, wherein said output information comprises said characterization and interpretation of said plurality of objects.

46-49. (deleted)

50. (currently amended) The apparatus ~~according to~~ of claim 26, wherein said instructions comprise naming and classifying objects known to said user.

51. (deleted)

52. (currently amended) The method of claim 27 ~~yet~~ further comprising:

providing a process of learning new facts about said physical surroundings of said person for growth and expansion of said World Model.

53. (previously presented) The method of claim 27 wherein said World Model hierarchically represents existing knowledge of the physical surroundings of said person; classes of said plurality of objects; the common relationships of said plurality of objects to their components; and the way low-level components in said hierarchy can be composed of regular surfaces.